PROCEDURE FOR THE PREPARATION OF FRUIT AND VEGETABLE PURÉES AND NECTAR COCKTAILS

The production industry for purées, nectars, cocktails or liquid solutions of fruit, vegetables or fruit and vegetable mixtures intended for human consumption has for many years sought to supplement the classic mechanical extraction or preparation techniques with the action of enzymatic reactions principally intended to solubilise pectins and consequently to obtain the benefits of the part of fruit and vegetables that goes to waste in classic extraction procedures. The advantage of this is twofold: on one hand economic as the volume of waste is reduced, and on the other nutritional due to the value of this waste for human consumption.

However, conducting these enzymatic reactions has proven to be quite delicate, particularly when processing vegetables, and this has led manufacturers to limit their use of enzymatic procedures to certain fruits or vegetables, only to use them to assist mechanical procedures, or finally only to apply them to a fraction of the fruits or vegetables concerned. In many cases, not all the nutrients with benefits for human consumption are salvaged and problems with viscosity or texture have been encountered with certain raw materials.

The procedure described in this invention, on the other hand, enables almost all the proteins, glucides, vegetable fats, mineral salts, trace elements and vitamins in the basic fruits and vegetables to be restored in the finished product. Only the following are eliminated during the procedure described in this invention:
- fruit stalks and sepals if necessary, mechanically, before the actual processing of the products;
- pips and stones, together with any vegetables, parts thereof and cellulosic parts that are not converted by the enzymes added or those naturally present in the product, at the end of the enzymatic reaction.

One of the features of the procedure lies in that the enzymatic reaction will be applied to a mixture of fruits, of vegetables or of fruits and vegetables devised according to various parameters such as:
- the nutritional balance of the product: the respective contents in vitamins, glucides and other nutrients are entirely balanced, bearing in mind the possible changes in the products during processing or before consumption;
- achieving an average pH between 3.4 and 4.2 to enable the enzymatic reaction to take place in satisfactory conditions, particularly in terms of the risk of microbe growth during the reaction and in terms of the maximum effectiveness of the enzymatic reactions.

At no point in the procedure are chemicals such as inhibitors, artificial preservatives, pH correctors or others added.

The installation is characterised by the inclusion of a fruit and vegetable sorting point to remove any attached stalks, sepals or leaves, followed by a washing point for the products, adapted for natural washing of the fruits and vegetables without the addition of chemicals.

Once the products are washed they are then grated or cut up more or less finely depending on their type, according to the speed with which enzymatic actions work on each of them, and are then sent to a blanching point which heavily reduces the microbe population (bacteria, yeast and mould) and largely prevents the later development of phenoloxydase reactions in the products. The blanching station is designed to achieve the desired result in a brief period of time (from 30 seconds to 5 minutes) and at a temperature of 80-95°C.

The blanched products are put into enzymatic reactors while still hot. The correct development of the enzymatic reactions is ensured by means of a suitable water/dry matter ratio. This water/dry matter ratio can be obtained:
- naturally in the case of some fruits or fruit mixtures;
- without the introduction of water by carefully calculating a suitable mixture of fruit and vegetables, possibly adding a certain proportion of fruit nectars from a previous preparation, produced using the same enzymatic procedure;

- by introducing a small quantity of water, about 5% ± 3% of the total mass of fruits and vegetables used, into a calculated mixture of fruits and vegetables. In the latter case, the quantity of water thus introduced will be removed by flashing at the end of the enzymatic reaction or during the final sterilisation of the product, or by any other applicable mechanism such as reverse osmosis, ultrafiltration, etc.

This quantity of liquid ideally comes from the blanching liquid, of which the surplus is kept from an enzymatic reaction as described below.

The enzymes used can be, for example, polygalacturonases, pectin lyases or any of the other enzymes most commonly used in mixtures, authorised for use in the preparation of products intended for human consumption.

Moreover, one of the original features of the procedure is that destroying all the natural enzymes at the blanching stage is not sought, but, on the contrary, preserving a sufficient fraction of these enzymes, in particular for the purposes of salvaging the proteins that they contain and making them easier to assimilate, is a desired outcome.

One of the original features of the invention is that natural proteolytic enzymes that are present in certain fruits chosen for this purpose are directly introduced at the enzymatic maceration stage. These enzymes are contained in fruit juices that are mechanically pressed without any other processing in order to prevent them from being destroyed, and these help to make the proteins contained in the fruit and vegetable mixture that will be used to make the cocktail easier to assimilate.

In the procedure used, the optimum pH of 3.5-4.2 for the development of the enzymatic reaction and the prevention of parasite growth during the enzymatic reaction is obtained naturally by carefully calculating the fruit and vegetable mixtures, if necessary – the overly high pH values of some vegetables are compensated for by the lower pH values of the fruits chosen as a result.

Throughout the duration of the enzymatic reaction, which may vary from 2-3 hours to 20-24 hours depending on the products, a temperature of 45-55°C is maintained in the reactor and the mixture is gently stirred. The reaction may be produced under inert gas if necessary to avoid oxidation and the development of aerobic fermentations. At the end of the enzymatic reaction, the mixture is stirred vigorously and filtered or sieved to remove pips and non-liquefied parts, lignins and fibrous parts, mainly. It can then be sterilised and packaged immediately or cooled to a temperature of 3-4°C and stored before later sterilisation and packaging.

To prepare fruit and vegetable nectar cocktails, a certain proportion of concentrated citrus fruits, red fruits or mixed natural fruit concentrates is added to the mixture before sterilisation, together with a certain proportion of honey, sweetener or other products with a sweetening capacity as appropriate, and also a small quantity of natural products rich in vitamins B and C and various essential nutrients (amino-acids and fats). The mixture thus produced may be smoothed or homogenised by a pressure of 10-100 bars: this process should preferably be carried out before sterilisation.

Using a specific method, the product will be sterilised for the production of fruit and vegetable nectar cocktails using the procedure developed by Mr Roland Torterot, the subject of European Patent EP 0 124 385 81, in which the product of the enzymatic reaction, with the addition of a certain quantity of citrus or other fruits, and if necessary honey or any other sweetening product, is heated to around 80-100°C and mixed counter-current with a carefully equivalent volume fraction of water superheated to a high temperature in order to obtain a suitable temperature (132-142°C) almost instantly for the sterilisation of the mixture and the destruction of the enzymes.

The quantity and temperature of the superheated water added are carefully calculated in order on one hand to obtain the temperature necessary for sterilising the product and destroying the enzymes, and on the other to ensure that the quantity of water thus added to the product is never greater than 5 times the quantity of citrus or other fruit concentrate added to the product beforehand: the total quantity of water is calculated also taking into

account the quantity of water added, if appropriate, before the enzymatic reaction, the removal of which by auto-evaporation may also take place at this point by auto-evaporation of the product between the sterilisation temperature and a temperature of approximately 95-110°C.

After a cooling period of 3-55 seconds, the product is chilled and packaged, ideally under inert gas, in long-life preservation packaging that is UV and oxygen-proof.

For finished product types other than fruit and vegetable nectar cocktails, other sterilisation equipment types may be used, for example depending on the consistency of the finished product for sterilisation, plate sterilisers or tubular sterilisers, and for the thickest products machines with a surface for scraping.

The description that follows makes reference to the accompanying diagrams which show a method of carrying out the procedure, as a non-limiting example.

The installation in figure 1 is a schematic representation of an installation that conforms to the invention, for the production of fruit and vegetable nectar cocktails.

Figure 2 is a representation of the blancher used to blanch the products after they have been grated or chopped.

The installation in figure 1. An initial manual and/or mechanical sorting point to remove peduncles, sepals and other undesirable elements. The fruits and vegetables are then washed at (2) without the addition of chemicals, then grated or chopped at (3).

The chopped or grated products are then blanched in (4) in a continuous machine described more fully in figure 2. The blanching temperature and sanitary conditions are maintained by recycling the blanching liquid which is pumped back up by a pump (5), heated in a heat exchanger (6), maintained at pasteurisation temperature in a holder and (7) and cooled to blanching temperature in the heat exchanger (6).

The blanched products, together with a fraction of the blanching liquid, are added to the enzymatic reactor (8) which is a cylindro-conical vat with an external thermal exchange circuit with an agitator/comminutor (9) driven by a speed-change drive unit with a range of 1 to 10 to enable both gentle stirring during the enzymatic reaction and vigorous stirring at the end of the reaction.

The reactor (8) may be pasteurised using steam in between the two enzymatic reactions, after washing, and may be placed under inert gas if need be during the enzymatic reaction.

After comminution, the liquid product obtained at the end of the enzymatic reaction is pumped (10) and filtered by a static filter for small installations or in a self-cleaning filter (11), or a continuous sieve for large flows.

The sieved product is sent to a degassing/auto-evaporation installation, formed, for example, by a constant-level tank (12), an accelerator pump (13), a heat exchanger (14), and a degasser (15) to enable the water added to the reactor (8) to evaporate.

On leaving the machine (15), the product is pumped back up (16), homogenised (17), and transported to a buffer tank (18) with an agitator and an external heat exchange circuit, where it can be cooled to 4/6°C if it is not sterilised in a short period of time.

A preparation/dosing station (19) enables sweetening products, fruit juice concentrates, vitamins and other products to be added to the product after the enzymatic reaction.

The product is then pumped back up (20), sterilised (21) and packaged (22).

All the vats and circuits may be cleaned by a built-in cleaning installation (23).

Figure 2 shows in more detail a type of blancher designed to meet the specific technological needs of this process: The equipment comprises a horizontal part with a solid base (31), a sloping part (32), the lower part of which is solid, made up of wedge-wire sieves to enable the product to drain into the intermediate part and including an opening to allow the product to exit in the upper part. The apparatus also includes two lateral waterproof sides.

The product is introduced into the lower part through an opening (30) and carried to the exit (40) by pallets fixed to lateral chains (36) made of stainless steel or plastic. The chains themselves are driven by a head gear wheel (33) and guided by intermediate (34) and tail (35) gears.

A level of blanching liquid is maintained in the apparatus thanks to the overflow threshold (41) between the solid part of the sloping base and the part made up of wedge-wire sieves. The blanching liquid flows into a hopper (37) which includes an exit pipe (38) which enables the product in the blancher to be recycled. A pipe (39) enables the blancher to be completely emptied at the end of the process.

The quantity of blanching liquid is permanently supplemented by means of a liquid level control in the hopper (37).

The temperature of the blanching liquid can be controlled by an external exchange loop as shown in figure 1 or a steam injection (43) in the hopper and a temperature control loop as shown in figure 2.

The length of part (32) is carefully calculated so that the quantity of blanching liquid leaving the blancher with the product to go to the enzymatic reactor is at the most 5% ± 3% of the total mass of fruits and vegetables used.

CLAIMS

1. Procedure for the preparation of purées, nectars, cocktails or liquid solutions of fruits, vegetables or fruit and vegetable mixtures, characterised by the fact that the fruits and vegetables are subjected whole, washed but not peeled, grated or chopped, to enzymatic reactions that use natural proteolytic enzymes and/or enzymes chosen from the galacto-pectinases or pectin lyases, thereby obtaining products which still have all the proteins, fats, mineral salts, trace elements and vitamins contained in the initial fruits and vegetables.

2. Procedure according to claim 1, characterised by the fact that the enzymatic reactions are used on mixtures of grated fruits, vegetables or fruits and vegetables at a pH of 3.4 to 4.2 for a period of 2/3 to 20/24 hours.

3. Procedure according to either of claims 1 and 2, characterised by the fact that the grated and chopped initial products are blanched before the enzymatic reactions in order to ensure that the microbe population is sufficiently reduced and to prevent any significant development of the phenoloxydase reaction.

4. Procedure according to any of claims 1 to 3, characterised by the fact that a percentage of water of approximately 5 percent of the fruits and vegetables used is added to the basic fruit and vegetable mixture in order to ensure a water/dry matter ratio sufficient for the satisfactory progress of the enzymatic reactions.

5. Procedure according to any of claims 1 to 4, characterised by the fact that the percentage of water added to the basic mixture comes from the liquid used for blanching the products before the enzymatic reaction.

6. Procedure according to any of claims 1 to 5, characterised by the fact that the quantity of water added to the mixture to enable the enzymatic reactions to progress well is removed by the auto-evaporation of the product after the enzymatic reactions or after the finished product is sterilised.

7. Procedure according to any of claims 1 to 3, characterised by the fact that the natural enzymes that are not destroyed at the blanching stage are used for their proteolytic activity during enzymatic maceration.

8. Procedure according to any of claims 1 to 3, characterised by the fact that natural proteolytic enzymes contained in pressed fruit juices, which are chosen for their abundance in these enzymes, are added at the enzymatic maceration stage in order to make the proteins in the fruit and vegetable mixture easier to assimilate.

9. Procedure according to one of claims 1 to 3, characterised by the fact that the water/dry matter balance required for the enzymatic reactions used to progress well is achieved by re-using a certain quantity of fruit purée prepared in advance using the same enzymatic procedure, or fruit juice.

10. Procedure according to any of claims 1 to 9, characterised by the fact that the basic mixture is vigorously mixed at the end of the reaction in order to obtain a fluid that can be pumped.

11. Procedure according to any of claims 1 to 10, characterised by the fact that residues, e.g. pips and lignocellulosic fragments greater than 1 mm in size, are removed by means of filtering or sieving.

12. Procedure according to claims 1 to 11, characterised by the fact that a certain proportion of concentrated citrus or other fruit concentrate is added to the product resulting from the enzymatic reactions for the purpose of preparing fruit and vegetable nectars and cocktails.

13. Procedure according to claims 1 to 12, characterised by the fact that supplementary natural nutrients such as various types of honey, sweetening products, products rich in B vitamins, vitamin C, and products containing

amino-acids and essential fatty acids are added to the product at the end of the enzymatic reactions, after any addition of citrus or other fruit concentrates.

14. Procedure according to any of claims 1 to 13, characterised by the fact that sweeteners are added to the product at the end of the enzymatic reactions, after any addition of other supplementary natural products.

15. Procedure according to any of claims 1 to 14, characterised by the fact that the foodstuff prepared as described is sterilised by counter-current mixing of the heated product with an amount of superheated water calculated so that the total added to the fruit concentrate during production is no greater than 5%.

16. Procedure according to any of claims 1 to 15, characterised by the fact that at the end of the enzymatic reaction the product, whether with the addition of fruit concentrates, honey, sweetening products, vitamins and essential nutrients or not, is sterilised in a tubular or plate machine, or one with a scraping surface.

17. Procedure according to any of claims 1 to 16, characterised by the fact that the foodstuff is smoothed or homogenised before sterilisation.

18. Procedure according to any of claims 1 to 17, characterised by the fact that the sterilised product, possibly smoothed and homogenised, is immediately placed in sterile packaging, if necessary under inert gas, either for direct sale to the consumer or in larger barrels or containers for other uses.

19. Installation for the implementation of the procedure according to any of claims 1 to 18, characterised by the fact that it comprises a manual or mechanised sorting point (1) for the stalks, sepals and other parts of the fruits and vegetables and a washing point (2), followed by a fruit and vegetable chopping or grating point (3), a dynamic blanching apparatus (4) where blanching is carried out using hot water which is constantly recirculated by a pump (5), heated and raised to pasteurisation temperature by the heat exchanger (6), cooled to room temperature at (7) and chilled to the desired temperature in the heat exchanger (6) before returning to the blanching apparatus (4) or going to the enzymatic reactor (8).

20. Equipment according to claim 19, characterised by the fact that the blanching apparatus comprises a stainless-steel trough with a part with a flat base (30), a sloping part with a solid base (31), a sloping part with a perforated base (32), preferably made up of wedge-wire sieves, and finally a free upper part (40) to enable the product to exit, with the blanched product being drained all along part (32) while the blanching liquid, collected in a chute (37), is discharged via a pipe (38) and recirculated into the blanching apparatus (4), and temperature control equipment (43) for the liquid collected in the chute (37), with a temperature regulator and steam injector, while a level control chain (42) is designed to maintain the level of the liquid in the chute (37), and two lateral chains (36), connected by feeder pallets, feed the product for blanching into the apparatus, the chains being moved by a drive gear (33) driven by a speed-change drive unit, one or two tail gears (35) and one or more intermediate gears (34), with a chute (44) intended for the entry of the product while a cover (45) partially protects the steeping section of the blanching apparatus (4), and this blanching apparatus (4) is completely drained in the chute (37) by a pipe (39).

21. Equipment according to either of claims 20 and 21, characterised by the fact that an enzymatic reactor (8) has been designed to receive the fruits and vegetables blanched by the blanching apparatus (4), made up of a vat with an external heat exchange circuit, equipped with a variable-speed agitator (9) to ensure both that stirring takes place continuously and at length throughout the enzymatic reaction and that the products are mixed vigorously at the end of the reaction, while the reactor (8) may be placed within a controlled nitrogen atmosphere during the reaction.

22. Equipment according to any of claims 19 to 21, characterised by the fact that, after the stirred mixture has been pumped up by the pump (10) at the end of the enzymatic reaction, the mixture is filtered or sieved using a

static or a self-cleaning filter (11) in order to remove pips, cellulosic parts, peel and other parts which are not converted by the enzymatic reaction.

23. Equipment according to any of claims 19 to 22, characterised by the fact that, in order to remove the water that may have been added to the filtered and sieved mixture at the blanching or enzymatic reaction stage, a set of equipment for heating by auto-evaporation has been designed, comprising a constant-level tank (12), an accelerator pump (13), a heat exchanger (14) and an auto-evaporation degassing flask (15), connected to a condensation circuit for the steam clouds extracted, and to a vacuum pump.

24. Equipment according to any of claims 20 to 23, characterised by the fact that a tank (18) equipped with an agitator and an external heat exchange circuit has been designed to receive the mixture when it has left the evaporation flask (15), been pumped up by a pump (16) and smoothed or homogenised at (17), this being for sterilisation and packaging purposes.

25. Equipment according to any of claims 19 to 24, characterised by the fact that it comprises a dosing station (19) for preparing and measuring honey, sweetening products, vitamins and other natural additives that are added to the product in the storage tank (18).

26. Equipment according to any of claims 20 to 25, characterised by the fact that it comprises a high-temperature steriliser (21) to sterilise the product prepared in (19) and an aseptic packaging machine (22) to package the sterilised product.

Schema 1	Diagram 1
eau	water
vapeur	steam
vide	vacuum

Schema 2	Diagram 2
produit	product
eau	water
sortie	outlet
vapeur	steam